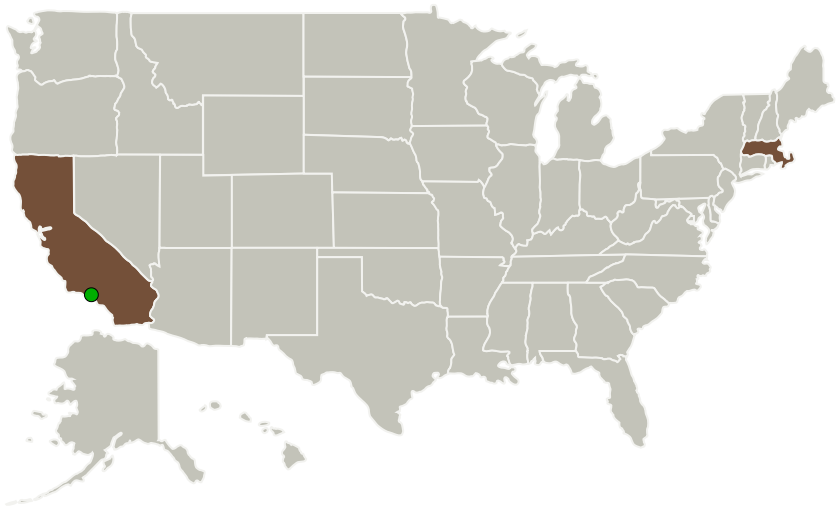
Miniaturized Low-Power Piezo Microvalve for NanoSat and CubeSat Propulsion, Phase II

Completed Technology Project (2011 - 2014)

Project Introduction

In the Phase I effort, Busek developed a miniature precision piezo-actuated microvalve weighing 32g and occupying 4.5 cm^3. The valve demonstrated continuous flow regulation of 0-12 sccm nitrogen (15psi supply pressure) thru 0-500 sccm nitrogen (1000psi supply pressure), with a leak rate of better than 1.0 x 10^-5 mbar-l/s. The simple, low part-count design was developed with a critical eye toward low-rejection rate manufacturability, with several sensitive assembly operations successfully advanced toward, robust, reliable processes. Resilience under aggressive shock loading, which exhibited negligible effects upon valve operation, was demonstrated. For the Phase II effort, Busek shall continue refining critical assembly processes to improve reliability in assembly, eliminating remaining elastomers in order to achieve an all-metal architecture. Additionally, a supplementary feature for downstream volume compensation (for regulation of incompressible liquids affected by induced flows due to mechanism actuation and/or liquid thermal expansion; a necessary feature for colloid thruster operation) shall be developed. Supporting the colloid application shall be valve driver electronics able to float at thruster beam Voltage. The design shall be validated via vibration and thermovac testing, and culminate in operation of both a gas-based thruster, as well as a colloid thruster to validate the volume compensation feature.

Primary U.S. Work Locations and Key Partners



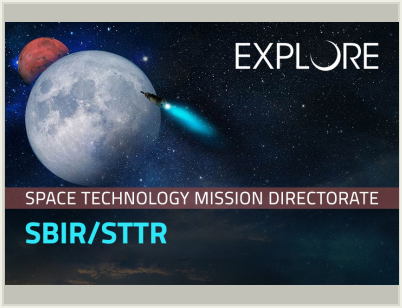


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Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

June 2011: Project Start

October 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137399)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Busek Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

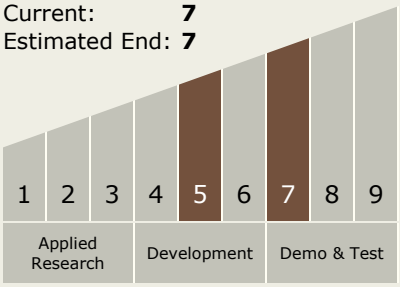
Carlos Torrez

Principal Investigator:

Douglas C Spence

Technology Maturity (TRL)

Start: **5**
Current: **7**
Estimated End: **7**



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Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System